CAREER PREPARATION STANDARDS

DRAFT INTERIM CONTENT AND PERFORMANCE STANDARDS

SUPERINTENDENT'S CHALLENGE INITIATIVE

THE CHALLENGE INITITATIVE

INTRODUCTION

The Challenge School District Reform Initiative calls on California's educators and parents to embrace a simple but powerful concept: school districts must set high content and performance standards for student achievement—stating clearly and publicly what each student should know and be able to do at the end of each year in each subject area. Schools are challenged to hold themselves accountable for results, reporting precisely how well their students are achieving and how many students are meeting the school district standards.

To further the Challenge Initiative, the following Draft Interim Content and Performance Standards, "Challenging Standards for Student Success," have been developed in language arts, mathematics, history-social science, science, health education, physical education, visual and performing arts, foreign language, applied learning, service learning, and career preparation. Each set of standards includes an introduction, standards by grade level, examples of the types of work students should be able to do to meet the standards, and samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standards. Some sets of standards also include samples of student work that meet the standards, and a few have short commentaries on these samples.

The draft Challenge Standards are a product of collaboration among representatives of school districts interested in the Challenge Initiative, curriculum specialists, teachers, and California Department of Education staff. Small working groups began the initial development of the standards in October 1995 and work on them continues, using as a basis the national standards including those from the New Standards Project; school district standards; California curriculum frameworks; and *Every Child a Reader* and *Improving Mathematics Achievement for All California Students*, the Superintendent of Public Instruction's 1995 task force reports on reading and mathematics. In December 1995 the working groups submitted their drafts to the California Department of Education. The complete set of draft Challenge Standards was distributed to representatives of the school districts interested in the Challenge Initiative at a meeting in Sacramento on December 14, 1995.

Several national and state reform efforts promote the development of standards. The New Standards Project, for example, builds on content standards developed by national professional organizations to design an assessment system based on world-class standards of student performance. Improving America's Schools Act of 1994 (IASA) requires school districts to measure student progress toward achieving rigorous state content and performance standards. California Assembly Bill 265, enacted in 1995, also requires the California State Board of Education to adopt academically rigorous statewide content and performance standards.

As part of the Challenge Initiative, participating school districts will now begin to (1) determine how the draft Challenge Standards relate to local standards, (2) gather samples of student work related to each standard, and (3) examine the student work to determine whether or not students are able to meet each standard.

When completed, the content and performance standards will establish a clear set of expectations for what students should know and be able to do at every grade level. These standards are in draft form and continue to be refined. Therefore, any comments are appreciated. General comments and questions about the draft Challenge Standards may be directed to the Assessment Office at (916) 657-3011. Specific comments and questions may be directed to the individuals listed below.

LANGUAGE ARTS

Division Director	Glen Thomas	(916) 657-3351
	(916) 657-5021 FAX	
Working Group Leader	Wendy Harris	(916) 657-5409
	(916) 657-5021 FAX	
Working Group	Diane Levin	(916) 657-5236
	(916) 657-5021 FAX	
	Nancy Sullivan	(916) 654-1123
		(916) 657-5437 FAX

MATHEMATICS

Division Director	Glen Thomas	(916) 657-3351
		(916) 657-5021 FAX
Working Group Leader	Wendy Harris	(916) 657-5409
		(916) 657-5021 FAX
Working Group	Joan Akers	(916) 657-4276
		(916) 657-5460 FAX

SCIENCE

Division Director	TBA	
Working Group Leader	Dave Hammond	(916) 657- 5373
		(916) 657-3467 FAX

HISTORY-SOCIAL SCIENCE

Division Director	Glen Thomas	(916) 657-3351
		(916) 657-5021 FAX
Working Group Leader	Wendy Harris	(916) 657-5409
		(916) 657-5021 FAX
Working Group	Rod Atkinson	(916) 657-3153
		(916) 657-5021 FAX

FOREIGN LANGUAGE

Division Director	Thaddeus Dumas	(916) 657-4399 (916) 657-4399 FAX
Working Group	Arleen Burns	(916) 657-5441 (916) 657-5021 FAX

VISUAL AND PERFORMING ARTS

Division Director	Thaddeus Dumas	(916) 657-4399 (916) 657-4399 FAX
Working Group Leader	Janice DeBenedetti	(916) 657-5315 (916) 657-5460 FAX
Working Group	Patty Taylor	(916) 654-5979 (916) 657-5460 FAX

HEALTH/PHYSICAL EDUCATION

Division Director	Thaddeus Dumas	(916) 657-4399 (916) 657-4399 FAX
Working Group	Jennifer Ekstedt	(916) 657-3387 (916) 657-3467 FAX
	Shirley Hazlett	(916) 657-2810 (916) 657-5149 FAX

CAREER PREPARATION/APPLIED LEARNING/SERVICE LEARNING

Division Director TBA

Career Preparation

Agricultural Education	Charles Parker	(916) 445-5636 (916) 445-5637 FAX
Business Education	Bernie Norton	(916) 445-5678 (916) 445-5639 FAX

Health Careers Education	Beverly Campbell	(916) 657-2541 (916) 657- 2638 FAX
Home Economics Careers and Technology	Janice DeBenedetti	(916) 657-5315 (916) 657-5460 FAX
Industrial and Technology Education	Chris Almeida	(916) 657-5425 (916) 445-5636 FAX
Applied Learning	Chris Almeida	(916) 657-5425 (916) 445-5636 FAX
Service Learning	Mike Brugh	(916) 653-7971 (916) 657-4969 FAX

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 6–8

EXPLORING TECHNOLOGY

INTRODUCTION

Industrial and technology education (ITE) programs are respondent to the complexity of advancing technology and the rapidity of technological change with educators, administrators, and business and industry partners working together to prepare students for careers of choice and lifelong learning. Students are discovering that education in a single discipline and skill preparation specific to a current job is no longer adequate for success in a technological culture. Students in ITE programs today are mastering curricula featuring basic scientific principles, mathematical concepts, and communication skills upon which work and learning are based. Students successfully completing an ITE program will use their understanding and skill to adapt as careers and technology change.

Industrial and technology education in California is a kindergarten through university continuum of well-planned, coordinated, articulated, integrated and sequential, activity-based programs. It is concerned with the processes, materials, and systems of technology, their development, use, and importance. It is concerned with industry, its organization, processes, resources, systems, and products. It is concerned with social-economic and environmental influences of industry and technology. ITE programs help all students to understand their technological culture, enabling them to make rational decisions about their own lives and provide a positive contribution in the increasingly technological workplace.

The exploring technology education program at the middle grades is a broad-based exploratory experience designed for all students. Using recommendations from the *Caught in the Middle* report, the explorations program seeks to acquaint students with technology through hands-on experiences, while reinforcing the academic core language arts, math, science, history/social science, and visual and performing arts. The explorations program seeks to meet the needs of the "at-risk" students by providing them with positive learning experiences. The constant technological change in society requires students to possess a strong foundation in the academic core areas and a broad base of career awareness.

The explorations program is based on the modular delivery system. The modular system encourages the students to become responsible for their own learning. Students work in pairs, using a set of self-directed instructions that guide the student through the learning activity. Students rotate from one module to the next every five or eight days. Students change partners on each rotation, and prepare for life by learning to work with other students.

The activities in the explorations program are grouped into the five cluster areas: biotechnology, communications, construction, manufacturing, and energy and transportation. The biotechnology cluster exposes students to the "fast plants" technology and the ever-increasing biomedical industry. Students are shown where the advances in the construction, manufacturing, energy, power, and transportation sectors influence advances in communication systems. Students explore the construction cluster through activities that include house construction, bridge building, city planning, and other phases of construction. Students are exposed to the manufacturing cluster with activities such as robotics, research and development, composites, and (CNC) computer numerical control. The energy and transportation cluster challenges the student to learn about small gas engines, pneumatics, simple machines, and air and space transportation.

The explorations program at the middle grades allows all students to learn about the technology that affects their daily lives through hands-on activities while reinforcing the academic core. As a result of participation in an exploring technology education program, the student will be able to make informed career, occupational, and educational decisions based on the knowledge and skills acquired at the middle school level.

For detailed exploring and technology standards, please refer to the "Industrial and Technology Education Career Path Guide and Model Curriculum Standards" publication.

STANDARD 1: BIOTECHNOLOGY

Students will understand the application of biology and technology. They will demonstrate/explain methods of biotechnology in the investigation of living systems.

Examples of the types of work students should be able to do to meet the standard:

- Students identify two applications of biotechnology.
- Students monitor a vital function of a living system.
- Students explain the use of biotechnology in waste management.
- Students identify two careers in the area of biotechnology.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Hydroponics Plant Growth

Students are provided with a hydroponic growing system and will prepare a growing medium and nutrient solution. Using provided materials, students germinate seeds. After germination, seedlings are transplanted into the growing medium. Students monitor plant growth and environment factors. Data are recorded/graphed and interpreted and placed in their portfolio.

STANDARD 2: COMMUNICATIONS

Students will understand a variety of communications processes and their importance in communications technology. They will use different processes and media to communicate a message.

Examples of the types of work students should be able to do to meet the standard:

- Students identify two methods of communications.
- Students produce a drawing on a computer.
- Students write and edit a document on a computer.
- Students present an idea using a form of audio communications.
- Students identify two careers in the area of communications.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Radio - Broadcasting Recording

Students are provided with audio reference materials and equipment. Students will learn how to operate equipment and will develop a radio broadcast program based on their script. The recorded tape will then be presented to the teacher for evaluation.

STANDARD 3: CONSTRUCTION

Students will understand a variety of construction processes and their importance in construction technology. They will build models/projects incorporating these processes.

Examples of the types of work students should be able to do to meet the standard:

- Students identify three processes of construction.
- Students explain the purpose of triangular shapes used in construction.

- Students interpret a floor plan of a simple structure.
- Students construct a functional model truss.
- Students identify two careers in the areas of construction.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Construction

Student design, construct, and test a scale model of a test structure using provided materials and equipment. Students evaluate the efficiency of the design and, using their findings, create a multimedia report describing how the structure's design could be modified to be more efficient. Students present their report to community members working in related fields for evaluation.

STANDARD 4: MACHINE AND TOOL SAFETY

Students will understand safe and appropriate use of tools and machines. Students will demonstrate the correct operation of tools and machines to form, separate, combine and condition materials.

Examples of the types of work students should be able to do to meet the standard:

- Students demonstrate the safe use of a machine.
- Students explain the safe use of two hand tools.
- Students identify two careers in the area of machine and tool safety.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Machine and Tool Safety

Hand tool use and demonstration: Students are provided with a teacher-directed safety demonstration (live, slides, videotapes). Students observe, study and demonstrate the proper use and operation of hand tools. Students are evaluated on the safety procedures.

STANDARD 5: MANUFACTURING

Students will understand a variety of manufacturing processes and their importance in manufacturing technology. They will create models/products incorporating different processes.

Examples of the types of work students should be able to do to meet the standard:

- Students identify two manufacturing processes.
- Students explain the process of producing a product using the universal systems model.
- Students create a flowchart/plan of procedure for a manufacturing product.
- Students identify two careers in the area of manufacturing.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Universal Systems Model

Students are provided with reference materials (state-approved AIT videotapes) covering the universal systems model (input, processes, output, feedback). Students list the steps in the universal systems model and draw an example of the universal system model to be evaluated by the teacher. The drawing will be placed in their portfolio.

STANDARD 6: MATERIALS

Students will understand how raw materials are collected and processed to produce industrial materials. They will demonstrate/explain processes and testing used to produce and recycle common industrial materials.

Examples of the types of work students should be able to do to meet the standard:

- Students identify three industrial materials.
- Students differentiate between raw materials and industrial materials.
- Students identify three materials that can be recycled.
- Students identify two careers in the area of materials.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Materials – Identification

Students are provided with reference materials (books, videotape, software, laser discs, CD ROM). Students use an activity sheet to identify five raw materials and five industrial materials. The activity sheet is evaluated by the teacher and then placed in their portfolio.

STANDARD 7: POWER AND ENERGY

Students will understand sources and systems of power and energy. They will build models/projects incorporating different processes.

Examples of the types of work students should be able to do to meet the standard:

- Students construct a simple machine.
- Students identify and describe three sources of energy and how they are utilized.
- Students construct a simple electrical circuit.
- Students identify and explain the function of three basic electronic components.
- Students explain the difference between pneumatics and hydraulics.
- Students identify two careers in the area of power and energy.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Power and Energy – Simple Machines

Students are provided with reference materials on simple machines (books, videotapes, software, laser discs, CD ROM). Students use these materials to study how simple machines work and how they are used in mechanical systems. Students create a functional mechanical device containing at least two simple machine components.

STANDARD 8: TRANSPORTATION

Students will understand the application of transportation technology to land, water, air, and space. They will incorporate the technology into the design and construction of a model/functional vehicle.

Examples of the types of work students should be able to do to meet the standard:

- Students identify and describe three modes of transportation.
- Students identify and describe the four principles of flight.

- Students create a model of a functional vehicle.
- Students identify and describe the environmental and social implications of transportation technology.
- Students identify two careers in the area of transportation.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Flight – Research and Development

After correctly following plans to build a model airplane/glider, students perform ten test flights. Students are provided with an activity sheet to record information (longest flight, average distance, air time, length, weight) pertaining to the flight. Students interpret the flight data in order to improve the model's performance in future flights. The completed activity sheet will become a part of their portfolio.

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 9–10

TECHNOLOGY CORE

STANDARD 1: COMMUNICATIONS

Student will understand communication systems which include telecommunications, technical and computer aided drawing, graphic communications, and photography and motion pictures. Students will safely complete a variety of authentic activities involving communication systems.

Examples of the types of work students should be able to do to meet the standard:

- Students read, interpret, and create drawings using universally accepted drawing conventions and standards.
- Students use sketching techniques, conventional drawing instruments and computer-aided drawing systems to produce drawings.
- Students use various graphic arts processes in the design and production of visual image products.
- Students incorporate photographic and motion picture processes and systems in the production of visual images that record, entertain, illustrate, and/or interpret information.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Students are provided with a block diagram, AM receiver, oscilloscope, and cable required to measure the amplitude of a radio frequency (RF) signal. They measure and observe the positive and negative modulation of several RF signals using the oscilloscope. They will complete a report on their findings and provide reasoning for why radio and television must be regulated by the Federal Communications Commission.

STANDARD 2: TRANSPORTATION TECHNOLOGY

Students will understand modes of transportation for people and goods, including propulsion systems, controls, and related infrastructures. They will explore historical and contemporary resources used to transport people and goods, and will describe related systems and processes.

Examples of the types of work students should be able to do to meet the standard:

- Students construct models of the various transportation modes and prepare related reports that compare these modes, their applications, related safety considerations, and impact on the environment and the society.
- Students engage in modeling activities that recognize the importance of propulsion, control, and structural support systems used in transportation.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Completing initial studies in lift, thrust, drag, roll, pitch, the forces of gravity, and aerodynamics, students will design model airfoils and lifting bodies and test the results of their designs in a wind tunnel or water flow table. They may experiment with pre-printed designs and/or their own designs. A competition course is set up in order that students will have the opportunity to measure distance, flight time, trajectory, and altitude behaviors of their designs. All measurements are recorded, averages calculated, and modifications predicted and made to improve qualities of performance. Parallels to general as well as aerospace design/production strategies and techniques are drawn and discussed.

STANDARD 3: ENERGY TECHNOLOGY

Students will understand energy sources, extraction and conversion processes, transmission, conservation, and storage systems. They will work cooperatively on authentic and authentic-based device and/or computer energy technology modeling activities and will describe related systems and processes.

Examples of the types of work students should be able to do to meet the standard:

- Students verbally describe at least five different energy resources and demonstrate the advantages and disadvantages of each as the resources are modeled using collaboratively developed systems.
- Students work cooperatively to construct working models of conversion processes and transmission systems which require the use of instruments to measure units of energy and work.
- Students work cooperatively to construct working models and analyze examples of extraction processes, conservation systems, or storage systems, and prepare a report incorporating findings from their model.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Students research and design a horizontal axis wind machine capable of generating an output of 20 watts to 30 watts. Students begin with the research, design, construction, and testing of a small-scale horizontal axis wind machine, incorporating a direct current (DC) motor rated within a range of 1.5 volts to 6 volts DC. This "breadboard" model is constructed from a coat hanger, electrical tape, corks, and similar low-cost materials. The wind powered electrical generator is then tested under varying conditions to determine factors that affect its operation and output. A research journal including notes, computations, graphs, and other details of this experimental model are used in the design of the larger capacity generator.

STANDARD 4: PRODUCTION TECHNOLOGY

Students will understand planning and design, constructing and servicing structures, electro/mechanical systems, materials and processes, computer-aided manufacturing, and production management as they relate to construction and manufacturing activities. The students will demonstrate a pragmatic understanding of these manufacturing concepts through the production of products.

Examples of the types of work students should be able to do to meet the standard:

- Students work individually or cooperatively to demonstrate an understanding of these construction concepts through the construction of models and/or the written analysis of actual construction examples.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Students, individually or in small groups, are given the problem of constructing a bridge made of 30 poly beams, capable of supporting a load of 34 ml of liquid that must traverse a 300 mm span. The only bonding material is 500 mm of masking tape. They investigate the problem, determine a solution and complete a set of plans for their design solution, and test their bridge. They complete a written report defending their design solution and describing their test results.

STANDARD 5: BIOTECHNOLOGY

Students will understand microbiotechnology and biomedical technology processes and systems. The student will work individually or cooperatively to produce a product of fermentation and/or solve a selected problem through an application of bioprocessing.

Examples of the types of work students should be able to do to meet the standard:

- Students work individually or cooperatively to produce a product of genetic engineering, an experimental prosthesis or other three-dimensional, working model of ergonomic design, and/or develop and use a biotelemetry system to record a selected physiological activity.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Students will understand micro-biotechnology processes (e.g., fermentation, bioprocessing) incorporating the use of living organisms to produce commercial products. They work individually or cooperatively (student teams) to produce a product of fermentation and/or solve a selected problem through an application of bioprocessing.

STANDARD 6: COMPUTER APPLICATIONS

Students will understand computer applications as they apply to present and future areas of technology. Students will demonstrate their understanding by discussing the various uses of the applications.

Examples of the types of work students should be able to do to meet the standard:

- Students individually and cooperatively incorporate computer software, hardware, and peripheral devices in a minimum of two selected communication, transportation, energy, production, or biotechnology activities as demonstrated in pragmatic or written forms.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Students organize a student company, design a printed product, and produce the product for sale using graphic reproduction processes that include computer word processing and desktop publishing, silk screening, and offset printing processes.

STANDARD 7: TECHNOLOGY AND THE ENVIRONMENT

Students will understand past, present and future impacts of technological developments on the environment and will discuss the application of the various technology/environment uses.

Examples of the types of work students should be able to do to meet the standard:

- Students address technology/environment-related concepts, recycling, resources, waste in a minimum of two oral presentations or written reports prepared contextually with activities in communication, transportation, energy, production, or biotechnology.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Students identify the uses of fossil fuel, describe the chemical composition of fossil fuel, explain their combustion as a chemical reaction, analyze major problems of using such fuels, and evaluate possibilities for replacing fossil fuels with alternative sources of energy. Students then study the environmental impact of the automobile and the vehicle systems utilized to regulate and monitor levels of hydrocarbons, carbon

monoxide, nitrous oxide, and carbon dioxide produced. They will then read a brief history on the development of the automobile and identify reasons for making major changes in the design of the automobile. Students will analyze the costs of automobile use in their own community for commuting to and from school. They will then investigate and discuss the advantages and disadvantages of fossil fuels and alternative fuels for commuting automobiles. They will research and summarize in writing legislation affecting the automobile industry.

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 11–12

CONSTRUCTION TECHNOLOGY

INTRODUCTION

Standards in construction technology address introductory core, wood product manufacturing, and building industry concepts and skills that affect people in virtually every walk of life. Collectively, construction technology standards provide a model for the development of construction technology program curricula from high school programs through lifelong instructional delivery systems, including retraining and upgrading programs. Curriculum designed from these model standards prepare individuals for employment or advanced training in a variety of related industries. Programs operating on standards-based curricula provide the work force with skilled workers, technicians, supervisors, and managers.

Construction technology programs in California provide students with the skills to enter the work force at the entry level directly out of high school and ROC/P, the technical level after community college or apprenticeship program, and the professional level after receiving a baccalaureate degree. This sequence begins after the "technology core" program with a broad-based "Introduction to Construction" course. The career-path sequence is then tailored to each individual student's goal by providing opportunities to enroll in programs such as Carpentry, Construction Equipment Operation, Furniture Making, Heating and Air Conditioning, Masonry, Plumbing, Electrical Wiring, Millwork and Cabinetmaking, Surveying, and Construction Management.

STANDARD 1: CORE

Students will understand and apply the principles of planning, layout, materials, assembly, and finishing processes used in construction technology.

Examples of the types of work students should be able to do to meet the standard:

- Students interpret prints and apply the information to basic planning and layout processes.
- Students select and safely use appropriate tools, machines and materials, following standard assembly procedures.
- Students select finishing materials and safely perform finishing processes in an environmentally responsible manner.
- Students demonstrate ability to apply math skills to solving problems in construction technology.
- Students apply communication skills by reading, presenting oral and written information, and listening to and following directions while performing construction assignments.
- Students apply their understanding of all aspects of the construction industry by maintaining a portfolio of activities related to their construction technology experiences.

STANDARD 2: FURNITURE AND WOOD PRODUCT MANUFACTURING

Students will understand and demonstrate furniture, wood products, and mass production technology processes, including entrepreneurial applications.

Examples of the types of work students should be able to do to meet the standard:

- Students select and safely use tools and machines to produce cabinets, furniture and wood craft products.
- Students participate in planning, scheduling, producing, packaging, and marketing mass-produced wood products.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Mass Production

Students will work in small groups (teams of three to four students), students select a product that can be mass produced (select something such as a pot holder, cassette holder, breadbox, etc.). Each of those teams builds a prototype, and presents a written and oral report to the class, including a rationale for their selection, a cost analysis, and a production plan. The students, through a democratic process, select the product to be mass-produced from among those presented to the class. They then organize a company, develop a production flow chart on a computer, assign responsibilities, and mass-produce the product. Each team analyzes the total experience and submits written recommendations for the future. (Standards 1, 2)

STANDARD 3: RESIDENTIAL AND COMMERCIAL BUILDING CONSTRUCTION

Students will understand and apply the procedures, techniques, equipment, and materials unique to residential and commercial building construction.

Examples of the types of work students should be able to do to meet the standard:

- Students describe and apply techniques in site preparation, forming and placing concrete foundations, framing, installing mechanical systems, and finishing a residential structure.
- Students describe and apply techniques, skills, materials, equipment, and procedures employed in light and heavy commercial construction.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Kingpost Roof Truss

Students work in teams of two, and using standard reference material, students collaborate in the design and layout of a gable-roof, Kingpost truss for a garage measuring 20’ x 24’ with 6” unit rise and a 1’ overhang. Each team does a full-sized layout on the floor using a measuring tape, framing square, and chalk line. Each member of the team checks the accuracy of the layout by figuring the rafter length (hypotenuse) using the Pythagorean theorem and then calculates the amount and cost of framing material needed to complete the roof. Individual students complete the assignment by laying out and building a flat Kingpost roof truss model of the garage to 1/4 scale and labeling the structural members.

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 11–12

DRAFTING TECHNOLOGY

INTRODUCTION

Standards in drafting technology address the technical world's primary means of communication, various forms of visual communications that affect people in virtually every walk of life. Collectively, drafting technology standards provide a model for the development of drafting technology program curricula from high school programs through lifelong instructional delivery systems, including retraining and upgrading programs. Curricula designed from these model standards prepare individuals for employment or advanced training in a variety of related industries. Programs operating on standards-based curricula provide the work force with individuals who can plan, prepare, and interpret mechanical, architectural, structural, marine, piping, electrical, electronic, topographical, and other drawings.

Drafting technology programs in California provide students with the skills to enter the work force at the entry level directly out of high school and ROC/P, the technical level after community college, or the professional level after receiving a baccalaureate degree. This sequence begins after the "Technology Core" program with a broad-based "introduction to drafting" course. The career path sequence is then tailored to each individual student's goal by providing opportunities to enroll in programs such as mechanical drafting, architectural drafting, technical illustration, electronic drafting, and civil drafting.

For detailed drafting standards, please refer to the "Industrial and Technology Education Career Path Guide and Model Curriculum Standards" document.

STANDARD 1: DRAFTING FUNDAMENTALS

Students will understand concepts of basic drafting that include measurement, lettering, sketching, and dimensioning practices. They will measure accurately, apply appropriate lettering techniques and fonts when creating drawings, produce well-proportioned and easily understood two and three-dimensional sketches, and apply dimensioning practices for drawings using the current standards of dimensioning and tolerancing for a variety of drafting applications.

Examples of the types of work students should be able to do to meet the standard:

- Students use scales (architects, metric, civil, and mechanical).
- Students use drawing equipment.
- Students use drafting media.
- Students use common symbols and abbreviations.
- Students demonstrate lettering styles.
- Students perform freehand lettering.
- Students properly sketch a drawing.
- Students apply basic dimension techniques.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Lettering

Given functional criteria of a problem and necessary conventions, students apply appropriate lettering for that application using correct tools, media, and materials.

STANDARD 2: ORTHOGRAPHIC DRAWING

Students will understand, identify and correctly use the alphabet of lines, and will develop an object graphically using appropriate projection techniques.

Examples of the types of work students should be able to do to meet the standard:

- Students use the six principle views.
- Students demonstrate materials of projection.
- Students differentiate line procedure (priority).

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Orthographic Drawing

Given specific criteria and necessary conventions of a problem, students accurately develop and draw the given object graphically using appropriate techniques, tools, and equipment.

STANDARD 3: SECTIONING

Students will understand section view applications/functions. They will incorporate section views and appropriate cutting planes to clarify hidden features or objects on drawings.

Examples of the types of work students should be able to do to meet the standard:

- Students use sectional symbols.
- Students draw types of sections.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Sectioning

Given a set of working drawings, students identify the appropriate type of section(s), and placement of cutting plane(s) for greatest clarification of hidden features and details, and apply this information correctly to the drawings.

STANDARD 4: PICTORIAL DRAWING

Students will understand the structure, components, types, sequential construction methods, and applications of pictorial assemblies, and will draw objects accurately in pictorial format.

Examples of the types of work students should be able to do to meet the standard:

- Students construct axonometric drawings.
- Students construct oblique drawings.
- Students construct perspective drawings.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Pictorial Projection

Students choose a method of pictorial projection and draw an assembly of a simple multipart object.

STANDARD 5: COMPUTER-AIDED DRAFTING/DESIGN AND OPERATIONS

Students will understand how to use the appropriate hardware and design software to create geometry and apply dimensioning practices to complete drawings. Drawings are to be organized using accepted CAD procedures. They will apply appropriate software file-management procedures. Students will produce hard copies of the completed drawings and provide electronic files for a variety of graphic outputs.

Examples of the types of work students should be able to do to meet the standard:

- Students operate CAD equipment and peripheral equipment.
- Students manage data.
- Students apply CAD to generate drawings.
- Students store and retrieve drawings.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Computer Aided Drafting/Design and Operations

Students complete drafting design problems in several drafting disciplines using correct drafting conventions and then apply appropriate dimensioning standards. ANSI Y14.5, architectural, electrical and metric standards are applied to the respective drawings. Students organize drawing according to accepted CAD procedures using prototypes for A-E paper sizes, which include layers, colors and all applicable parameters. Students keep records of all files on log sheets, organize them into categories, and keep backups of all files. Completed solutions are output to a variety of hard copy devices and/or are prepared for use in shading and animation software. Students prepare a variety of file formats and understand how they are used to transfer files.

STANDARD 6: RESEARCH AND DESIGN

Students will understand research and design strategies that are environmentally safe and appropriate to manufacturing and/or construction product development in selected technologies. They will incorporate research and design strategies as they relate to the universal problem-solving approach in the development of manufacturing and/or construction products.

Examples of the types of work students should be able to do to meet the standard:

- Students determine client needs.
- Students understand environmentally safe criteria.
- Students develop a design for a manufacturing and/or construction product to meet a client's needs.
- Students evaluate the product in light of its function and meeting the client's needs.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Bridge Design

Students, individually or in small groups, are given the problem of constructing a bridge made of 30 poly beams, capable of supporting a load of 354 ml of liquid that must traverse a 300 mm span. The only bonding material is 500 mm of masking tape. They will investigate the problem, determine a solution and complete a set of plans for their design solution, and test their bridge. They will complete a written report defending their design solution and describing their test results.

STANDARD 7: MECHANICAL DRAFTING

Students will understand concepts of mechanical drafting.

Examples of the types of work students should be able to do to meet the standard:

- Students calculate and apply correct tolerance conventions to drawings.
- Students select and use the appropriate materials and methods to reproduce original drawings.
- Students organize and complete an assembly drawing using information collected from detail drawings.
- Students develop geometry of three-dimensional objects and manipulate the drawings, applying hidden line removal, shading, and animation.
- Students construct, structure, form, design, and geometrically define objects and surfaces.
- Students utilize primary and, when applicable, secondary auxiliary planes and revolutions.
- Students apply the symbology with respect to the function of the parts and design intent.
- Students develop and draw flat layouts of a variety of objects.
- Students complete the various types of working drawings using appropriate line work, symbology, and current standards.
- Students complete piping drawings to current industry standards using appropriate symbols.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Working Drawings

Students arrange and interpret a group of detail drawings into their assembly drawings. Students produce correct detail drawings as required for these assembly drawings. The assembled drawing will then be organized into a working drawing.

STANDARD 8: ARCHITECTURAL DRAFTING

Students will understand concepts of architectural drafting. They will explain the technological changes that have occurred throughout the history of architectural drafting. They will select and use professional architectural drawing procedures that are consistent with current industry standards, develop architectural working drawings using current industry standards, and complete structural drawings to current industry standards.

Examples of the types of work students should be able to do to meet the standard:

- Students sketch residential preliminary layouts.
- Students construct plot plans.
- Students design and construct residential floor plan.
- Students dimension floor plans.
- Students construct foundation plans.
- Students construct typical wood frame wall section drawings.
- Students construct architectural elevations.
- Students construct residential roof framing plans.
- Students construct residential electrical plans.

- Students construct architectural plumbing system plans.
- Students prepare windows, door, and finish schedules.
- Students construct stair detail drawings.
- Students construct fireplace detail drawings.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Construction Details

Students draw, to scale, various parts of a building as individuals or as a group project. Students develop and draw, to scale, typical wood and concrete foundation details. Students calculate and draw to scale typical door and window openings including all framing members from predetermined criteria and draw, to scale, a typical wall framing plan. Students draw, to scale, a longitudinal section and a transverse section of a building. Students complete a detail sheet representing commonly used eave or overhang details. Students draw, to scale, the head, jamb, and sill of commonly used doors and windows. Students draw stair details and typical fireplace detail. Students draw framing details at the floor and top plate for post and beam construction.

STANDARD 9: ELECTRONIC DRAFTING AND DIAGRAMS

Students will understand electronic drafting and diagrams. They will classify and use various electronic components, symbols, abbreviations, media, and standards of electronic drawings to draw appropriate block, schematic, wire and cable, and logic diagrams using current industry standards.

Examples of the types of work students should be able to do to meet the standard:

- Students use electronic component symbols.
- Students draw block diagrams.
- Students draw schematic diagrams.
- Students draw wire and cable diagrams.
- Students draw logic diagrams.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Electronic Wiring and Cable Drawings

During group discussions and visual samples, students interpret and calculate wire sizes and their voltage-carrying capacities from a series of electronic drawings. Given an electronic circuit sketch with designated input and output voltages, students determine the size of wire or cable required for the circuit and current flow for this drawing. Students convert the sketch to an appropriate electronic drawing using the proper wire size and voltage conventions.

STANDARD 10: CIVIL DRAFTING

Students will understand geographic, typographic, and cadastral mapping techniques, and will apply geographic, topographic and cadastral mapping techniques to drawing using current industry standards.

Examples of the types of work students should be able to do to meet the standard:

- Students illustrate types of civil drawings.
- Students reorganize legal land descriptions.

- Students interpret field data for drawings.
- Students utilize mapping procedures.
- Students construct typographic maps.
- Students construct geographic maps.
- Students construct cadastral maps.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Civil Drafting

Using a legal description of a parcel of land, students draw the location of the property to scale. Using bearings of line, azmuth, and deflection angles, students draw to scale traverses of specific parcels of land. Students research why there is a magnetic and true north. Using surveying equipment, students survey the school property and locate various features or buildings on the site. Students interview an individual employed in the civil drafting area and prepare a report on areas of employment and pertinent information on skills.

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 11–12

ELECTRONICS TECHNOLOGY

INTRODUCTION

Electronics technology programs prepare individuals for employment or advanced training in a variety of electronic industries. These programs prepare individuals to work as technicians, engineers, and professionals who perform research and design, manufacturing, maintenance and service functions. Instruction includes theory, the underlying physical science and supporting mathematics, actual equipment, electronic and mechanical devices, test equipment, and analog and digital circuitry. Instruction ranges from preparation in assembly, installation, operation, maintenance, and repair of a variety of mechanical, fluid, electrical and thermal systems used in the electronics industry. Further training prepares individuals in the application, design, development, and testing of equipment and electronic interfaces. Individuals will be prepared to communicate effectively with co-workers, supervisors and clients. These individuals can solve technical problems and present oral and written reports.

Electronics technology programs in California provide students with the skills to enter the work force at the entry level directly out of high school and ROC/P, the technological level after community college, or the professional level after receiving a baccalaureate degree. This sequence begins after the "technology core" program with a broad-based "introduction to electronics" course. The career-path sequence is then tailored to each individual student's goal by providing opportunities to enroll in a variety of electronic technology programs.

For detailed electronics technology standards, please refer to the "Industrial and Technology Education Career Path Guide and Model Curriculum Standards" document.

STANDARD 1: HISTORY OF ELECTRICITY/ELECTRONICS

Students will understand the historical developments in electricity and electronics which have led to the current technology. They will explain the impact of the historical developments and discoveries on current technology.

Examples of the types of work students should be able to do to meet the standard:

- Students discuss the history of electronic technology.
- Students use terminology unique to electronic technology.
- Students discuss and reference state and federal regulations.
- Students read and interpret color codes.
- Students read and interpret electronic symbols and drawings.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

History of Electronics

Students select a theory of electronics and a modern device which applies to this theory. Students trace the history and development of their devices from inception to the present day using museums, books, interviews, or correspondence with manufacturers, etc., as resources. Students write essays in which they describe how the early theory of electricity, and the fundamental principles of science and math, evolved into the technology exemplified by the device they researched. Students present their findings to the class and predict what new devices might be invented in the future as electronic theory and technology advance.

STANDARD 2: ELECTROMOTIVE FORCE

Students will be familiar with various forms of energy, such as electrical, mechanical, chemical, thermal, piezoelectric, solar, etc., and will understand how conversion processes can transform one form into another. They will apply conversion technology to generate electricity.

Examples of the types of work students should be able to do to meet the standard:

- Students discuss and explain matter, energy, and basic electronic theory.
- Students identify sources of electricity.
- Students relate electricity to the nature of matter.
- Students define voltage, current, resistance power, and energy.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Sources of Electricity

Students generate electricity through experimentation. Possibilities include using a lemon and several different metals, a silk scarf and a glass rod, a small electric motor turned by a drill motor. Students report their findings in written, oral, or video-taped formats. Groups of students working on different methods of generating electricity could compare their findings based on current, and voltage output.

STANDARD 3: UNITS OF MEASURE

Students will understand how electricity is made of interactive measurable forces; voltage, amperage, resistance, and power. They will analyze and predict effects of circuit conditions based on measurements and calculations of voltage, current, resistance, and power.

Examples of the types of work students should be able to do to meet the standard:

- Students identify components and interpret data sheets.
- Students solve basic algebraic problems as applicable to electronics.
- Students apply and relate Ohm's law.
- Students read and interpret color codes to identify resistors.
- Students measure properties of a circuit using VOM & DVM Meters.
- Students compute and measure conductance and resistance of conductors and insulators.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Definition of Units

Given the electrical properties and electrical units of measurement for a simple electric circuit, students differentiate between proprieties and units of measure. Students define terms such as voltage, volt, current, and ampere orally to the instructor. Students use these terms correctly when speaking about circuits to one another or to the instructor.

STANDARD 4: DIRECT CURRENT CIRCUITS

Students will analyze relationships between voltage, current, resistance, and power related to direct current circuits. They will calculate, construct, measure and interpret direct current circuits. In addition, students will identify components and interpret data sheets.

Examples of the types of work students should be able to do to meet the standard:

- Students analyze, construct, and troubleshoot series circuits.
- Students analyze construct, and troubleshoot series - parallel circuits.
- Students analyze, construct, and troubleshoot voltage dividers (loaded and unloaded).
- Students solve network theorem problems using Kirchoff, (V & I), Thevenin, Norton, superposition, and delta-wye.
- Students analyze, construct, and troubleshoot maximum power transfer theory.
- Students define magnetic properties of circuits and devices.
- Students determine physical and electrical characteristics of capacitors and inductor.
- Students analyze and measure RL and RC time constants.
- Students set up and operate VOM for DC circuits.
- Students set up and operate DVM for DC circuits.
- Students set up and operate power supplies for DC circuits.
- Students set up and operate oscilloscopes for DC circuits.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

DC Circuit Calculations

Given known values of resistance, voltage, and current for series, parallel, or complex DC circuits, students calculate and solve for circuit unknowns using Ohm's Law, Kirchoff's Law or Watt's Law. Students compare the results for different circuit types and report the differences or similarities in written or oral form.

STANDARD 5: ALTERNATING CURRENT CIRCUITS

Students understand how alternating current is generated, its characteristics, the sine wave, basic characteristics of alternating current circuits, tuned circuits, resonant circuits, and the nature of the frequency spectrum. They calculate and apply the principles of alternating current to design various AC circuits. In addition, students will identify components and interpret data sheets.

Examples of the types of work students should be able to do to meet the standard:

- Students solve basic trigonometric problems as applicable to electronics.
- Students identify sources and properties of an AC signal.
- Students analyze and measure AC signals using oscilloscope frequency meters and generators.
- Students analyze, construct, and troubleshoot capacitive circuits.
- Students analyze , construct, and troubleshoot AC inductive circuits.
- Students analyze and apply principles of transformers to AC circuits.
- Students analyze, construct, and troubleshoot RLC circuits (series, parallel, complex).

- Students analyze, construct, and troubleshoot series and parallel resonant circuits.
- Students analyze, construct, and troubleshoot filter circuits.
- Students analyze, construct, and troubleshoot polyphase circuits.
- Students analyze basic motor theory and operation.
- Students analyze basic generator theory and operation.
- Students set up and operate VOM for AC circuits.
- Students set up and operate DVM for AC circuits.
- Students set up and operate power supplies for AC circuits.
- Students set up and operate oscilloscopes for AC circuits.
- Students set up and operate frequency counters for AC circuits.
- Students set up and operate signal generators for AC circuits.
- Students set up and operate capacitor-inductor analyzers for AC circuits.
- Students set up and operate impedance bridges for AC circuits.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Basic AC Circuit Evaluation

Students construct, analyze, and troubleshoot alternating current capacitive circuits, inductive circuits, parallel resonant circuits, filter circuits, polyphase circuits. Technical service reports that simulate those used by industry are written to describe findings and are submitted for evaluation.

STANDARD 6: ANALOG CIRCUITS

Students will understand analog circuits. They will identify, describe, and trace signal paths in the operation of basic electronic stages relating to AM, FM, television, and other similar devices.

Examples of the types of work students should be able to do to meet the standard:

- Students analyze, construct, and troubleshoot single-stage amplifiers.
- Students analyze, construct, and troubleshoot multistage amplifiers.
- Students analyze, construct, and troubleshoot power supplies and filters.
- Students analyze, construct, and troubleshoot differential and OP amps.
- Students analyze, construct, and troubleshoot power supply regulators.
- Students analyze, construct, and troubleshoot active filters.
- Students analyze, construct, and troubleshoot oscillators.
- Students use meters and test equipment with analog circuits.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Subassembly Identification

Confronted with a simple schematic diagram, students locate and identify the various stages of an AM or FM radio. They verbally or physically point out and describe the operation of the states such as the power supply intermediate amplifier.

STANDARD 7: BROADCAST/COMMUNICATIONS SYSTEMS

Students will know the principles of basic electronic communications systems including wireless and hardwire communications systems. They will analyze the characteristics of different communications systems and use this information to select appropriate solution to a given communications problem.

Examples of the types of work students should be able to do to meet the standard:

- Students diagnose and troubleshoot audio systems.
- Students demonstrate understanding of theory, diagnostics, and troubleshooting of video systems.
- Students demonstrate understanding of theory and principles of radio frequency.
- Students demonstrate understanding of methods of modulation and demodulation.
- Students perform operational test of the radio transmitting system.
- Students demonstrate an understanding of theory and troubleshoot the AM receiver.
- Students demonstrate an understanding of theory and troubleshoot the FM receiver.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Broadcast Equipment Testing

Given an AM or FM radio broadcast system or simulator, students correctly perform operational checks and calibration procedures including audio levels and modulation levels. Students collaborate during the process to determine the most effective methods of measurement verbally or in written form throughout the exercise.

STANDARD 8: DIGITAL CIRCUITS

Students will understand number systems, logic functions, memory circuits, clock and timing circuits, and their applications to electronic systems. They will design and build digital circuits using combinational logic functions and troubleshoot digital systems to the individual chip level.

Examples of the types of work students should be able to do to meet the standard:

- Students perform digital mathematics.
- Students analyze, construct, and troubleshoot logic gates, flip-flops, multivibrator circuits, and integrated circuit logic devices.
- Students analyze, fabricate, and troubleshoot register and counter devices.
- Students analyze, construct, and troubleshoot clock and timing circuits.
- Students analyze, construct, and troubleshoot encoders and decoders.
- Students analyze, construct, and troubleshoot diplexers and multiplexers, RAM and ROM devices, A to D and D to A conversion devices, display devices, digital systems.
- Students troubleshoot digital systems in consumer products.
- Students troubleshoot digital systems in communication products.
- Students demonstrate understanding of firmware and software (programming).

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Logic Gates and IC Families

Given assorted TTL and CMOS IC logic gates and data sheets, students identify logic families, gate functions and truth table for the devices. Using appropriate test equipment, students verify power requirements, circuit operation, truth tables, and propagation delays for the devices. Students report their findings to the instructor using tables and graphs.

STANDARD 9: ELECTRONICS SYSTEMS AND SERVICING

Students will understand the technique of combining discrete electronic devices to form systems that can be used to complete specific tasks. They will analyze various electronics systems and describe the function of each device within the system. In addition, students will troubleshoot electronics systems down to the device level. Students will work in groups to design a customer-service network to provide field support for an electronics system and will conduct simple experiments to determine uses of biomedical equipment to monitor and control body functions. Students will analyze and define the relationship between fundamental QA elements and repetitive performance to achieve a QA goal. Students will conduct QA goal reviews to determine objective requirements, reliability, and safety criteria in order to troubleshoot and solve a QA problem.

Examples of the types of work students should be able to do to meet the standard:

- Students read and interpret radio and television receiving system block and circuit diagrams.
- Students determine the operational status of radio and television receiving systems.
- Students troubleshoot radio and television receiving systems.
- Students remove and replace radio and television receiving systems components.
- Students perform operating systems check and make minor adjustment to radio and television receiving systems.
- Students set up and operate video analyzers, NTSC generators, CRT analyzers.
- Students read and interpret video recording systems block and circuit diagrams.
- Students determine the operational status of video recording systems.
- Students troubleshoot video recording systems.
- Students remove and replace video recording system components.
- Students perform operating systems check and make minor adjustments to video recording systems.
- Students set up and operate Beta test equipment, VHS test equipment, and vectorscopes.
- Students read and interpret video disc player systems block and circuit diagrams.
- Students determine the operational status of video disc player systems.
- Students trouble shoot video disc player systems (laser/CED).
- Students remove and replace video disc player system components.
- Students rerform operating systems check and make minor adjustments to video disc player system.
- Students read and interpret computer system and video game block and circuit diagrams.

- Students determine the operational status of personal computer systems and video games.
- Students troubleshoot personal computer systems and video games.
- Students remove and replace personal computer systems and video game components.
- Students perform operating systems check and make minor adjustments to personal computer systems and video games.
- Students set up and operate logic analyzers for personal computer system.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Audio System Testing

Students refer to product manuals, service literature, and troubleshooting diagrams, on a supplied piece of audio equipment. Utilizing that reference material, they develop a sequence of steps in order to verify the conditional status of the equipment. Performance analysis includes oscilloscope measurement data on stage and/or system gain, frequency response, and distortion. Results are in report form including graphs, data, block diagrams, and overall conditional status evaluation.

STANDARD 10: SOFTWARE FUNDAMENTALS

Students will understand the fundamentals of DOS and programming for technicians and software diagnostics and will write, store, edit, and retrieve programs to troubleshoot systems or solve electronic mathematical problems. In addition, they will identify, define, analyze, and troubleshoot communications interfacing problems in systems and determine faulty units in the system for removal and/or repair.

Examples of the types of work students should be able to do to meet the standard:

- Students load and run operating system software and diagnostic software.
- Students construct and analyze flow charts.
- Students identify and define computer languages and their uses.
- Students write a simple computer program in basic.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Word Processing

Students understand and are able to correctly use at least one assigned work processor to create acceptable laboratory and technical reports. They will store, edit, recall, and print these reports.

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 11–12

GRAPHIC COMMUNICATIONS

INTRODUCTION

Standards in graphic communications technology address various forms of visual communications that affect people in virtually every walk of life. Collectively, graphic communications technology standards provide a model for the development of graphic communications technology program curricula from high school programs through lifelong instructional delivery systems, including retraining and upgrading programs. Curriculum designed from these model standards prepare individuals for employment or advanced training in a variety of related industries. Programs operating on standards-based curricula provide the work force with technicians, technical report writers, and supervision managers.

Graphic communications technology programs in California provide students with the skills to enter the work force at the entry level directly out of high school and ROC/P, the technical level after community college, or the professional level after receiving a baccalaureate degree. This sequence begins after the "technology core" program with a broad-based "introduction to graphic communications" course. The career-path sequence is then tailored to each individual student's goal by providing opportunities to enroll in programs such as printing technology, advertising design, commercial photography, and multimedia.

For detailed graphic technology standards, refer to the "Industrial and Technology Education Career Path Guide and Model Curriculum Standards" publication.

STANDARD 1: GRAPHIC DESIGN

Students will understand the application of basic graphic design principles to achieve specific goals. They will produce thumbnail sketches, rough layouts, and a comprehensive layout for a printed product.

Examples of the types of work students should be able to do to meet the standard:

- Students identify basic principles of design.
- Students identify process color and printing.
- Students identify basic color theory from artist (color wheel).
- Students prepare a series of differing thumbnail sketches for a printed piece.
- Students prepare completed rough layouts from a thumbnail sketch.
- Students prepare a comprehensive layout following a complete rough.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Graphic Design

Working from job specifications, including objective, size, copy, color(s), and theme, students working individually or in small groups prepare thumbnail sketches, a rough layout, and a comprehensive layout that includes all specifications. They complete thumbnail sketches and rough layout using traditional methods, applying principles of design and typography. The comprehensive layout may be prepared either manually or using computer technology. Included art work may be in the form of electronic or printed clip art, and may be scanned and manipulated with graphics software. Students check, copy, design, and layout for spelling and adherence to specifications, submit it to the client or instructor for correction or approval, and make additional corrections or changes as necessary. Each student maintains a personal log of each job worked on, procedures performed, and equipment, tools, and materials used.

STANDARD 2: PRINTING TECHNOLOGY

Students will understand art and copy preparation, reproduction photography procedures required for single and multicolor printing, single and multicolor image assembly and plate making, the offset press and the factors affecting its performance, and the binding and finishing processes. They will prepare camera-ready layouts for a variety of printed products, produce a variety of camera-ready past-ups for single and multicolor printed products, and produce line, halftone, and special effect negatives, stats, and contact prints as required for paste-up and image assembly. They will also prepare flats, proofs, and plates for single and multicolor printing; set up and print single and multicolor products with a minimum of waste; and find and finish notepads, brochures, booklets, business cards, and other printed products.

Examples of the types of work students should be able to do to meet the standard:

- Students identify the major printing processes.
- Students list in order the business flow of printing from initial need to final product.
- Students list in order the technical production flow from idea to finished product.
- Students produce paste-ups using the correct procedures, equipment, tools, and materials.
- Students produce headline and body type using the correct procedures.
- Students produce a single color flat with correct dimensions and cut outs.
- Students produce a correctly exposed and processed metal plate for offset printing.
- Students produce a direct and/or electrostatic plate for offset printing.
- Students produce printed single and multicolor jobs.
- Students produce correctly made notepads, brochures, booklets, business cards, and other printed products.
- Students make sets of paper using collating equipment in proper sequence.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

The Basic Printing Process

Students design a basic printed product, such as a notepad, which includes type and line art. They specify the type style, select clip art, specify the paper stock, ink color, binding, and finishing methods, and quantity required. They prepare a job jacket/ticket. They produce the type, prepare a state of the line art, rule out the dimensions on art board and paste up the copy and art, make a line negative, strip up the negative on preruled masking sheets, prepare a foil plate, print the specified quantity, and bind and finish the pads. They then prepare a written summary of the design and production process, a list of the equipment and materials used, and an evaluation of the quality of the finished product.

STANDARD 3: COMMERCIAL PHOTOGRAPHY

Students will understand the photographic process. They will produce black-and-white and color prints and slides of various subjects under natural and studio lighting conditions.

Examples of the types of work students should be able to do to meet the standard:

- Students produce a good quality negative.
- Students produce good quality black and white and color prints and slides under natural and studio lighting conditions.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Commercial Photography Assignment

Working individually or in small groups, students take on photo assignments for members of the school community. These might include photos at athletic events, academic competitions, drama production, and debates for publication in the school or local newspapers photos of award ceremonies, special assemblies and presentations; candids for the yearbook, etc. They select and load film suitable for the assignment, charge and/or replace batteries, adjust camera settings, and select correct lenses for the job. Each student keeps a detailed log of the equipment, material and, if possible, the exposures used on the job. After the shoot, students process the film and prepare contact or proof prints for the client's selection. They then make final prints as required. Income from the sales is used to replenish supplies and maintain and upgrade equipment.

STANDARD 4: MULTIMEDIA

Students will understand characteristics and uses of various types of nonprint media. They will produce a media project using current available technology designed to inform, teach, or sell.

Examples of the types of work students should be able to do to meet the standard:

- Students produce a basic video production.
- Students produce a hypermedia stark project.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Multimedia

Students working individually or in small groups produce a basic multimedia project, such as a video production, or hypermedia stack designed to inform, teach, or sell. They select the media, write the copy, prepare the script (story board), and select images to produce the finished project. Each student maintains a log of activities and durations. They then prepare a written summary of the design and production process, a list of the equipment and materials used, and an evaluation of the quality of the finished product and its effectiveness in achieving its purpose.

STANDARD 5: SCREEN PRINTING

Students will understand the screen printing process. They will print products on a variety of substrates using appropriate inks and procedures for each.

Examples of the types of work students should be able to do to meet the standard:

- Students design a basic screen printed product.
- Students prepare, expose, wash out and mask a screen.
- Students print a proof and complete the run from a screen they prepared.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Screen Printing Production

Working in small groups (teams of three to four) students are given a job jacket/ticket with camera-ready copy for a card, poster, T-shirt, sweatshirt, bumper sticker, or other screen-printed product. They make a line positive, prepare, expose, wash out, and mask the screen, select the specified substrate and ink colors, set up and adjust the frame or press, and print a proof for approval by the team leader and/or instructor. They complete the run, and when dry, they fold and trim as specified for the particular job. They count, package, and deliver the finished product, sign off the job ticket, and file the job jacket for future use.

STANDARD 6: SAFETY AND HEALTH IN THE GRAPHIC COMMUNICATIONS INDUSTRY

Students will understand the proper health and safety guidelines for each mechanical working area, including storage and recycling of raw materials and waste products. They will describe health and safety precautions in the graphic arts laboratory, procedures for storing and using materials and chemicals, power equipment, hand tools, listing of classification of fires and fire-fighting treatment for each, and define OSHA regulations that apply to printing and publishing.

Examples of the types of work students should be able to do to meet the standard:

- Students read and comprehend material safety and data sheets (MSDS).
- Students follow proper safety procedures when operating equipment.
- Students use approved methods to dispose of waste materials.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Press and Bindery Operations

Working in small groups (teams of three to four), students are given a job jacket/ticket with printing plates and specifications for a letterhead, flyer, brochure, booklet, or other printed product. They select the specified paper stock and ink colors, set up and adjust the printing press, and print a press proof for approval by the team leader and/or instructor. They complete the press run with an appropriate adjustment for waste depending on the number of passes through the press and the complexity of the binding and finishing operations. When dry, students fold, gather, stitch, glue, drill, trim, etc., as specified for the particular job. They count, package, and deliver the finished product, sign off the job ticket and file the job jacket for future use. The activity is performed using proper safety procedures, and waste materials are properly disposed. Each student maintains a personal log of each job worked on, procedures performed, and equipment tools and materials used.

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 11–12

MANUFACTURING TECHNOLOGY

INTRODUCTION

Standards in manufacturing technology address an introduction to manufacturing technology core, manufacturing systems, manufacturing processes, and an advanced section in welding processes, machine tool processes, and manufacturing enterprise. Collectively, manufacturing technology standards provide a model for the development of manufacturing technology program curricula from high school programs through lifelong instructional delivery systems, including retraining and upgrading programs. Curriculum designed from these model standards prepare individuals for employment or advanced training in a variety of related industries.

Manufacturing technology programs in California provide students with the skills to enter the work force at the entry level directly out of high school and ROC/P, the technical level after community college, or the professional level after receiving a baccalaureate degree. This sequence begins after the "technology core" program with a broad-based "introduction to manufacturing" course followed by an "advanced manufacturing" sequence of courses. The career-path sequence is then tailored to each individual student's goal by providing opportunities to enroll in programs such as machine tool, welding, fabrication, and synthetics.

For detailed manufacturing technology standards, refer to the "Industrial and Technology Education Career Path Guide and Model Curriculum Standards" publication.

STANDARD 1: PLANNING AND LAYOUT PROCESSES

Students will understand planning and layout processes (including designing, print reading, and measuring), used in manufacturing. They will read prints and use the information to plan, lay out, and produce parts or products.

STANDARD 2: MATERIAL PROCESSING

Students will understand how materials can be processed using tools and machines. They will use tools and the processes of cutting, shaping, combining, and forming of materials to manufacture a part or product.

STANDARD 3: ASSEMBLING PROCESSES

Students will understand various types of assembling processes (mechanical fastening, mechanical force, joining, fusion bonding, and adhesive bonding) used in manufacturing. They will apply appropriate fastening or joining procedures to the design and production of a manufactured part or product.

STANDARD 4: FINISHING PROCESSES

Students will understand finishing processes (types of finishing materials, surface preparation, and methods of application) used in manufacturing. They will select a finishing process for a product in terms appropriate to the job it must perform, environment in which it functions, and its aesthetic appeal.

STANDARD 5: QUALITY CONTROL

Students will understand inspection and quality control in the manufacturing process. They will perform continuous on-line inspections to ensure that parts or products meet design specifications.

STANDARD 6: MANUFACTURING SYSTEMS

Students will understand a variety of technology systems which include conventional, automated, and emerging manufacturing systems. They will select and use appropriate conventional tools, machines, and inspection devices to manufacture a part or product. They will use computers to design and produce products, control robots and machines, and write numerical control programs. They will explain how emerging systems can be integrated into current manufacturing processes.

STANDARD 7: WELDING PROCESSES

Students will understand a variety of welding machines and welding processes used in manufacturing, maintenance, and repair. They will perform welding processes necessary to complete a fabrication, assembly, or repair consistent with American Welding Society practices. They will read and interpret prints which use standard American Welding Society welding symbols to plan, lay out and produce welded parts or products. They will produce weldments using proper preparation procedures and welding processes to counteract and minimize such undesirable defects as corrosion, oxidation, distortion, stress, and arc blow. They will use appropriate industrial forming tools to prepare parts and ensure proper fit and finish. They will use oxyfuel processes of forging, flame cutting, brazing, soldering and welding to produce useful parts or products. They will produce weldments using appropriate machine setup and electrode types indicated by material type and size, weld position, joint alignment and type, deposition rate and bead finish. They will identify special welding or cutting processes (SMAW underwater, plastics welding, friction welding, FRW electron beam, EBW industrial robots, plasma arc cutting PAC, etc.), describe circumstances in which they are typically used, and explain their advantages or disadvantages.

STANDARD 8: MACHINE TOOL PROCESSES

Students will understand the operation and function of machine tools in production and prototype work. They will select appropriate processes and machines to efficiently produce or manufacture a part or product. They will follow industry-approved dimensioning standards using geometric tolerance and drawing interpretation skills when machining parts or products. They will safely use fixtures, vices, rotary devices, chucks, and hold-down clamps to secure work for machine tool operation. They will use industry-approved tooling, setups, feeds, cutting speeds and manufacturing techniques to manufacture parts or products on the lathe. They will select and safely test grinding wheels for specific machines and applications using industry-approved standards. Students will use pedestal grinders and surface grinders to manufacture and finish grind parts or products. They will use precision instruments to inspect machine products or parts as per American National Standards Institute standards. They will lay out, machine, and inspect parts or castings manufactured.

STANDARD 9: INDUSTRIAL FORMING

Students will understand industrial forming processes and their application to specific types of materials. Students will produce a part or manufacture a product using appropriate casting, forging, molding, cold forming, and/or shearing processes.

STANDARD 10: MANUFACTURING ENTERPRISE

Students will understand the manufacturing organization, enterprise organization systems, and production technology, and management. They will develop a corporate structure which includes financing, management, and marketing systems. They will establish a management system which includes the planning, engineering, organizing, actuating, and controlling of resources and manufacturing. Students will perform manufacturing functions that include site management, finance, marketing, and community and labor relations. They will use project-based team learning to integrate all aspects of a manufacturing organization in creating a system that takes a product from inception to sales.

Examples of the types of work students should be able to do to meet the standard:

- Students form a corporation with class members.
- Students select a product from a given list.
- Students utilizing drafting tools or computer-aided graphic program, create a management team hierarchy, i.e., CEO, board of directors, and line managers.
- Students design a finance plan, using expertise similar to those used by local industry.
- Students manufacture and market a preselected product.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Production and Management

The students form a corporation with members from the class and then select a product from a given list. Using drafting tools or computer graphic programs, they create a management team hierarchy; i.e., CEO, board of directors, and managers. The students also design a plan to finance, manufacture and market a preselected product.

INDUSTRIAL AND TECHNOLOGY EDUCATION

GRADES 11–12

TRANSPORTATION AND ENERGY TECHNOLOGY

INTRODUCTION

Standards in transportation and energy technology address technical systems that comprise the foundation of our modern way of life. Collectively, transportation and energy technology standards provide a model for the development of transportation and energy technology program curricula from high school programs through lifelong instructional delivery systems, including retraining and upgrading programs. Curriculum designed from these model standards prepare individuals for employment or advanced training in a variety of related industries. Programs operating on standards-based curricula provide the work force with line mechanics, service managers, electronics specialists, diagnostic technicians, nuclear engineers, and aerospace engineers.

Transportation and energy technology programs in California provide students with the skills to enter the work force at the entry level directly out of high school and ROC/P, the technical level after community college or the professional level after receiving a baccalaureate degree. This sequence begins after the "Technology Core" program with a broad-based "Introduction to Transportation and Energy" course. The career path sequence is then tailored to each individual student's goal by providing opportunities to enroll in programs such as ASE automotive, ASE auto body repair, ASE truck and diesel, and FAA aircraft.

Transportation and energy technology education programs form a powerful and positive integrated linkage with all other disciplines. Knowledge and skills across disciplines are enhanced and reinforced, which enable students to compete in our economy as productive citizens. These programs are provided within the context of a total sequential program, wherein a student will be able to plan intelligently and properly prepare for a career goal.

For detailed transportation and energy technology standards, please refer to the "Industrial and Technology Education Career Path Guide and Model Curriculum Standards" document.

STANDARD 1: SAFETY

Students will understand safety in the transportation industry that includes mechanical and toxic hazards. They will operate and use equipment in the shop safely and efficiently, develop a list of environmental hazards, and discuss ways of dealing with health and safety concerns.

STANDARD 2: TOOLS AND EQUIPMENT

Students will understand how specific tools and equipment are used to perform maintenance and repair operations. They will select and use the correct tool or piece of equipment required to perform diagnostic and repair procedures in the shop. They will follow industry-approved standards when using the measuring tools and measurement systems required in diagnostic and adjustment procedures.

STANDARD 3: APPLICATION OF PRINCIPLES

Students will understand physical, chemical, environmental, mechanical, and electrical principles used in transportation. They will use scientific principles to explain how energy systems function and malfunction. Students will apply industry-specific hazardous communications and materials regulations to their workplace situation. They will use basic mechanical principles to analyze and explain the function, function possibilities and design of vehicle and energy systems.

STANDARD 4: INTERNAL AND EXTERNAL COMBUSTION

Students will understand the operating principles of internal and external combustion engines. They will diagnose and analyze internal and external combustion engine performance.

STANDARD 5: HYDRAULIC AND PNEUMATIC POWER

Students will understand the basic principles of hydraulic and pneumatic power. They will explain applications of hydraulic power to generate electricity, mechanical movement and force multiplication. They will explain applications of pneumatic power to generate electricity, mechanical movement and force multiplication.

STANDARD 6: POWER AND ENERGY

Students will understand how power is developed from mechanical, chemical, nuclear and alternative energy sources. They will explain energy conversion from electrical to mechanical and chemical forms as related to transportation vehicles. They will describe the basic operation of a nuclear reactor and explain how atomic energy can be converted to perform work. They will describe potential applications of alternative power sources.

STANDARD 7: TRANSPORTATION SYSTEMS

Students will understand land, water, and aerospace transportation systems. They will describe the difference between types of vehicles, types of roadways, and the construction of highways, streets and railroad road bed. They will explain how to make a piece of steel float and the operation and control of various water transportation vehicles. They will explain basic propulsion systems and roll, yaw, and pitch control systems. They will explain batching of products in pipelines.

STANDARD 8: BASIC ELECTRICITY AND ELECTRONICS

Students will understand the application of electrical elements (volts, amps, ohms, watts) in vehicle circuits and equipment. They will use tools such as meters and schematic diagrams to diagnose, service and repair circuitry and components in various types of electronic devices and systems.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Breadboard Construction of Electrical Circuits

The student is given a breadboard, hookup wire, electrical components, electrical schematic diagrams, 13.5 volt power source and a multi-meter. The student builds the electrical circuits as specified in the schematic diagrams. All of the circuits are typical of those found in an automobile.

STANDARD 9: DIAGNOSIS AND RESOLUTION

Students will understand how maintenance procedures, factory manuals, research procedures, fault analysis and resolution are integrated to diagnose and repair transportation and energy systems. They will use various types of information retrieval systems in a systematic approach to determine specifications and repair/service procedures. They perform and document maintenance procedures in accordance with the recommendations of the manufacturer. They will test and replace, repair, or adjust components to bring them into factory specifications.

Examples of the types of work students should be able to do to meet the standard:

- Students perform service writer function, greet customers, listen to customer's automotive malfunction complaint, and prepare cost estimates using industry pricing and repair codes to identify the work in accordance with the Bureau of Automotive regulations.
- Students prepare a technician's work order listing customer complaints and desired repairs using industry repair codes to identify the work.
- Students verify the customer complaint, diagnose engine problems, remove the engine from the vehicle, disassemble, clean components, perform precision measurements to determine component condition, and repair or replace as needed. Reassemble, adjust and reinstall the engine to industry standards.
- Students prepare a list of replacement parts, machine work, sublet services, revise the initial cost estimate, and contact the customer for their continued approval as costs change as per Bureau of Automotive Repair requirements.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Engine Repair

The student performs all of the tasks involved in a simulated industry setting where a customer brings a vehicle that needs major engine repair to a shop. The student does all of the work possible in the setting and sublets machine work that cannot be performed.

STANDARD 10: BUSINESS PRACTICES

Students will understand leadership/management and business practices used in the transportation and energy fields. They will generate and maintain service records in a manner consistent with current legal and industry requirements. They will demonstrate leadership and management skills such as total quality management (TQM) in their class and leadership activities.

Samples of specific activities or tasks that give students the opportunity to demonstrate that they can meet the standard:

Frame and Glider Kit

ROP/Community College students working in an open lab situation and in teams of four perform all business and repair functions consistent with the truck repair industry and to BAR and trucking industry standards.

Students receive a class 8 tractor that has been involved in a bad highway accident in which the frame has been bent and the cab has been demolished. They interview the owner and discuss the various options available for repairing the vehicle. The owner decides that because the truck is fairly new and has only 500,000 miles on it, he wants to replace the frame, install a glider kit and overhaul and repair each of the components on the truck as needed. The team of students researches the costs of parts, the inspection and repair procedures for each component, and gives the owner a preliminary estimate. They have the owner sign the repair order and liability waiver. Team members then order the parts needed to start the work. Team members then strip the truck down to the ground, evaluating each component and repair/rebuilding as needed as they proceed. The truck is then reassembled by the team. During the rebuilding process, the instructor closely monitors the work in progress and makes verbal suggestions to the team regarding the work and procedures. At the completion of the work the team makes out the bill and presents it to the owner while being supervised by the instructor.

Energy

Students working in teams in an open lab environment design and lay out on the floor of the lab a power generating facility. They are to use three different energy sources (hydraulic, fossil fuel, and nuclear). The generating capacity is to be for a city of 5,000 homes and 200 businesses. All elements of a generating facility are to be included. Students will also develop a power grid for the city. Power voltages should go from high voltage transmission to residential use.